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SPALLING OF MARBLE ON WASHINGTON MONUMENT

In connection with some proposed repair work on the Washington Monument, this Bureau is cooperating with Office of National Parks, Buildings, and Reservations in a study of marble masonry joint treatments. The point in question is to determine on a method of preventing the spalling which occurs on the marble facing. This spalling has been going on for several years and has reached such a stage as to mar the appearance of the lower portion of the obelisk. It occurs mainly on the lower 150 feet of the structure and affects the marble mainly along the horizontal mortar joints. A possible explanation is that the marble is supporting more than its share of the superimposed weight, and that this results in the spalling. With uniform distribution of the load over a horizontal section of the masonry at the ground level and maximum wind pressure, no part would be stressed as much as 700 lb./in.² Tests recently made on blocks of the same material which had been exposed to the weather for about 70

years indicated a bearing power of more than 5,000 lb./in.² Hence the spalling and cracking of the marble indicate that it is actually stressed much more than the theoretical 700 lb./in.²

Details of the early construction of the Monument are not available, but it is believed that a rubble masonry filling exists between the outside marble ashlar and inside walls of granite ashlar. Thin mortar joints in the ashlar masonry and thicker mortar joints in the rubble fill would account for uneven distribution of the loading.

The experiments now in progress are for the purpose of determining if a proposed plan of widening the horizontal marble joints for an inch or more from the surface and refilling with a more elastic mortar will overcome the spalling. For this purpose it was considered desirable to use marble of the same kind as that in the monument and which had been exposed to the weather for a similar period of time. Some blocks were taken from the top of the old Patent Office Building for the experiments, since the marble in it came nearest to satisfying these conditions.

THE INFLUENCE OF NEIGHBORING STRUCTURES ON THE WIND PRESSURE ON TALL BUILDINGS

In studying wind pressure on tall buildings a question frequently arises as to the effect of neighboring structures; that is, whether the erection or the removal of neighboring buildings will endanger the safety of an existing structure. This question cannot be completely answered by the results from a single example; nevertheless, the behavior in one case may reveal the general nature of the effect.

Measurements have been made in the Bureau's 10-foot wind tunnel on a model of the Empire State Building in the presence of 2 models that might be erected on the adjacent squares. The pressure was measured at 3 levels on the Empire State model for 24 wind directions and at 3 speeds.

The results show that the neighboring structures in some instances increase the pressure on the windward face, but the suction on the lee face is simultaneously decreased, and the resultant of the two, which is the loading on the building as a whole, is decreased. Hence, it is difficult to see how the erection of nearby structures could cause increased loadings on existing structures, and, judging by this one example, there is no hazard of this kind.

The shielding effects are quite large when the interfering structure is on the windward side and nearby, the loading being reduced to as low as one seventh of the value when freely exposed. The area shielded does not, however, extend to the full height of the interfering structure. If, in the original design, the wind loads have been reduced to allow for the shielding of existing structures, dangerous conditions might occur if the neighboring structures were removed.

The shielding effects of buildings on the lee or to the side are very small.

The results show that shielding may produce a variation in the twisting moment about a vertical axis at different levels. This effect may cause trouble in special cases, since the stresses due to twisting moments are not ordinarily taken into account in the design of buildings.

Research Paper no. 637 in the January number of the Bureau of Standards Journal of Research contains the complete account of this investigation.

SOIL CORROSION STUDIES, 1932

In 1922 the Bureau began a study of the action of soils on underground pipes. Short lengths of all of the then commonly used kinds of ferrous pipes were buried in 47 representative soils without regard to their corrosiveness. At later dates additional specimens of ferrous and nonferrous materials were buried in the same and other locations. At intervals of approximately 2 years specimens have been removed, examined, and reported upon. A report on the specimens removed in 1932 has recently been completed and will be published as Research Paper No. 638 in the Bureau of Standards Journal of Research for January 1934. The amount of corrosion occurring depends upon various conditions, including the nature of the soils in which the specimens were buried, the composition of the materials tested, and the way in which the test was conducted. Information on these conditions is given in earlier reports, particularly Bureau of Standards Technologic Paper T368, which describes the soils and the plans of the investigation; Research Paper No. 329, which gives data on ferrous specimens removed in 1930 and earlier, and Research Paper No. 359, which contains similar information on nonferrous materials and metallic protective coatings.

The data presented in the latest paper confirm the tentative conclusion previously drawn that soil characteristics are the most important factors in determining underground corrosion. All commonly used ferrous materials corrode similarly underground. Small differences in the behavior of different materials may be noted but they do not appear to be very important and it is difficult to determine whether the observed differences are really significant or only accidental.

All metallic coatings under test appear to have reduced the rates of corrosion of the specimens to which they were applied, but a considerable number of these specimens show rust spots after 8 years' exposure to the more corrosive soils.

Copper and alloys high in copper appear to corrode less rapidly than ferrous materials in many if not all soils.

The last of the specimens buried in 1922 will probably be removed in 1934, and a complete report on the investigation will be prepared as soon thereafter as circumstances permit.

SOLARIZATION OF GLASS

During the past month the Bureau's radiometry section took occasion to summarize the results of an investigation which has been in progress for the past 3 years on the photochemical changes in glass, as recognized by changes in the ultraviolet spectral transmission when exposed to wide bands of filtered ultraviolet solar radiation, and also when exposed to isolated wave lengths of homogeneous radiation from the quartz mercury arc. The results to date are as follows:

It is impracticable to use filtered ultraviolet radiation from the quartz mercury arc in accelerating the stabilization ("aging") of the transmission of ultraviolet window glasses. Just as great accuracy is obtained by stabilizing the glass under unfiltered quartz lamp radiation.

Ultraviolet radiation of short wave lengths (254 to 300 millimicrons) has the greatest effect in reducing the transmission of window glasses. The greatest "antagonistic" action in rejuvenating the ultraviolet transmission of solarized glasses is produced by wave lengths in the region of 365 millimicrons.

For each wave length there is an equilibrium level of photochemical action (as recognized by the ultraviolet transparency), depending upon the previous exposure of the glass.

The shorter the wave length (between 254 and 365 millimicrons) of the homogeneous exciting radiation, the lower the equilibrium value of the transmission. If the ultraviolet transmission is below the equilibrium value, as the result of previous exposure to wave lengths shorter than the one under consideration, the exposure to this wave length increases the transmission to the equilibrium value. Similarly, if by heat treatment or exposure to wave lengths longer than the one under consideration, the transmission is raised above the equilibrium value for this wave length, then exposure to this wave length decreases the transmission to the equilibrium value. To what extent this change in equilibrium level in transmission is owing to more than one photochemical change in the glass is a problem requiring further investigation.

DIRECT CURRENT AMPLIFIER FOR RADIOMETERS

Since the invention of the electron tube, some 18 years ago, numerous arrangements of electric circuits have

been described for amplifying small electric currents; for example, from thermopiles and photoelectric cells. But few of these proposals have survived, and none have come into general use for making precise radiometric measurements. This is owing to the instability of the electronic circuit used and to the lack of provision for electrically standardizing the amplifier—a necessary procedure since there are no reliable sources of ultraviolet for standardizing the combined radiometer and amplifier.

Recently, considerable time has been devoted by the Bureau's radiometry section to assembling various combinations of screen-grid electron tubes and resistances to give the desired amplification, and testing their reproducibility from day to day. The materials employed (microammeter, screen-grid amplifier tubes, resistances, dry batteries, and photoelectric cells) are readily obtainable in commerce. The assembly is compact in form and easily transported—weight about 27 pounds.

During the past month the performance of the device has been studied intensively both in the field and in the laboratory.

It was found that, after a preliminary operation for 5 to 10 minutes to attain temperature equilibrium in the amplifier tubes, there is no fluctuation in the zero scale reading of the microammeter either (a) when testing the amplification sensitivity of the instrument, or (b) when making measurements of ultraviolet intensities of the sun and of artificial sources.

The indicator response scale reading was found to be linear within the accuracy of the microammeter used. Owing to the selective wave-length response of the photoelectric cell, this device like all selective radiometers, must be calibrated in absolute value by means of the standard balanced thermopile (differential actinometer) and filter radiometer.

SPECTRAL ERYTHEMIC REACTION OF THE UNTANNED HUMAN SKIN TO ULTRAVIOLET RADIATION

The erythemic reaction is a measure of skin tolerance to ultraviolet radiation, and is thus a means of avoiding burns. A knowledge of the spectral erythemic response of the untanned skin to ultraviolet radiation is, therefore, of importance in evaluating the output of ultraviolet lamps, especially lamps sold to the public for home use without the supervision of

an experienced physician. Before irradiating large areas of a new patient, a preliminary test should be made on a small area to determine the skin tolerance, and thus avoid burns.

As reported in the Bureau of Standards Journal of Research for April 1932 (Research Paper no. 433), a study has already been made of the spectral response of the skin of average pigmentation, i.e., excluding the extremes, blondes, and brunettes. In this manner, data were obtained whereby it is possible to determine the ultraviolet output of, and the approximate time of exposure to, a lamp without causing burns. In Research Paper no. 631, in the January number of the Bureau of Standards Journal of Research, a revision and extension to longer wave lengths of the data previously published, are given.

A NEW CATHODE-RAY OSCILLOGRAPH AND ITS APPLICATION TO THE STUDY OF POWER LOSS IN DIELECTRIC MATERIALS

A method has been developed at the Bureau for measuring the power loss in electrical insulating materials subjected to alternating voltages at commercial frequencies. By the use of a specially constructed, high-sensitivity cathode-ray oscillograph the power loss in a single cycle of alternating stress can be measured, and such measurements may be made continuously for considerable periods of time. While the method is not as precise as the usual balanced bridge method or wattmeter method for measuring power absorbed in a dielectric material, it is applicable under circumstances where the usual precision methods fail completely to give results. A continuous record may be made of the power absorbed by the specimen up to the instant that electrical breakdown occurs in the material. This should prove of use in studying the phenomena which accompany the breakdown. The method consists essentially in making a continuous record of the phase difference between the voltage on the specimen and the current through it. The power factor is obtained immediately from this, and the absorbed power is then computed from the voltage, the frequency, and the capacitance of the specimen. The method is equally applicable to specimens of very large or very small capacitance. Since the recording mechanism is an electron beam, no injury to the apparatus can result from the surges which accompany the electrical failure of the speci-

men. The new method is fully described in Research Paper no. 636, which will be published in the January number of the Bureau of Standards Journal of Research.

STUDIES OF THE IONOSPHERE AND THEIR APPLICATION TO RADIO TRANSMISSION

Observations of the virtual height of the ionosphere (Kennelly-Heaviside layer) and its variations have been carried out at the Bureau during the past few years. (Technical News Bulletins nos. 169, 175, and 198, May and November 1931, and October 1933). The pulse method of Breit and Tuve was used. With this method, pulses of radiofrequency energy about 0.0002 second long were sent out in all directions 90 times per second, and were picked up by a nearby radio receiver whose output was connected to an oscillograph. The oscillograph was equipped with a mirror which rotated in synchronism with the chopper or keying device at the transmitter. The pulses from the receiver controlled a beam of light to this mirror, so that for a given time of travel all of them struck the mirror in the same position and were deflected to the same spot on a screen and gave a stationary pattern. Pulses with a longer time of travel were deflected to a different position on the screen. The position of a pulse on the screen was used as a measure of the time of travel of the pulse for a round trip from the ground to the layer and back. Half of this time would be the time of travel upward, and this time multiplied by the velocity of electromagnetic wave propagation, 300,000 km per second, gives the virtual height of the layer. The position of the ground wave pulse on the screen remained stationary while the position of the sky-wave pulse shifted as the height of the layer changed.

In general, a number of layers were discernible, the major summer daytime layers being the lower or E layer at about 100 to 120 km virtual height, an F_1 layer at about 180 km virtual height, and an F_2 layer at about 240 km virtual height. These layers occurred for successively higher frequencies because as the frequency was increased the pulses penetrated layers of higher electron densities. The E layer was observed for a frequency range up to between 3,000 and 3,400 kc/s at noon, the F_1 for a frequency range from the upper limits of the E layer frequencies to between

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3,800 and 4,500 kc/s, and the F_2 layer for a frequency range from the upper limits of the F_1 layer up to between 5,000 and 8,000 kc/s. The diurnal and seasonal changes in these effects were very large and, for the most part, were attributed to the varying intensity of the sun's rays producing ionization on the layer overhead. However, there were many irregular variations which could not easily be explained. Abnormally strong E layers were observed at irregular intervals for periods of several hours. The F_2 layer returned higher frequencies on a summer evening and a winter noon than on a summer noon. These results seemed contrary to what should be expected because if the ionization were produced by the sun's radiation it should be a maximum near a summer noon. It is suggested that the F_2 layer critical frequency results may indicate an absorption of the waves during a summer noon rather than a penetration through the F_1 layer. If this is the case, very high frequencies may be expected to be reflected from the ionosphere under certain special circumstances. The earth's magnetic field resulted in double refraction and a splitting of reflections from a given layer. This was especially noticeable at the F_1 layer. It was indicated that at the maximum ionization of this layer, the retardations were subject to abnormal effects during magnetic disturbances. Research Paper No. 632 in the January number of the Bureau of Standards Journal of Research will contain the complete account of this work.

DEVELOPMENT OF STANDARD-FREQUENCY TRANSMITTING SETS

Research Paper No. 630, which will be published in the January number of the Bureau of Standards Journal of Research, discusses the methods used by national laboratories to make their standards of radio frequency generally available. The most accurate, economical, and practical method is considered to be the transmission of standard radio-frequency signals. In the United States these are transmitted by the Bureau of Standards, using continuous waves, although experimental work is now under way for the transmission of modulated waves, with both the carrier and modulation frequency serving as standard-frequency sources. At first these signals were sent on various frequencies between 125 and 10,000 kc/s. However, as

monitoring stations developed, transmissions over such a wide spectrum were found unnecessary. The demand then was for the transmission of a single basic frequency of extreme accuracy. For this reason the Bureau started transmissions on 5,000 kc/s, a frequency which was selected as being most suitable for wide coverage of the United States. Since 200 kc/s piezoelectric oscillators were used for control, a multiplication by 25 was necessary to obtain the output frequency. Synchronized oscillators and harmonic amplifiers, using both screen-grid and pentode tubes, were tried, the pentode harmonic amplifier being selected as the most satisfactory. In the final multiplier a distorting 200-kc/s amplifier is used, followed by tuned 1,000 kc/s and 5,000 kc/s.

The development work led to the purchase and installation of a 30-kilowatt transmitter at Beltsville, Md., 13 miles from the Bureau's main radio laboratory. Marked improvement in the coverage and dependability of the signals has resulted.

FOREIGN INTEREST IN BUREAU'S RADIO AIDS TO AIR NAVIGATION

The developments of the Bureau of Standards for enabling airplane pilots to fly and land blind are coming into use in several foreign countries. Recent notices indicate that these include England, France, Germany, and Switzerland. The Canadian government several years ago installed airway radiobeacons of the visual indicating type developed by the Bureau.

One of the most striking of these foreign adaptations of the American work is an installation at Tempelhof Field, Berlin, of the high-frequency radio beam for blind landing. The Deutsche Versuchsanstalt für Luftfahrt some months ago set up an experimental beam transmitter to test its efficiency. The results were so promising that a method and instrument were devised for controlling the shape of the landing path; a line of constant received intensity is not followed, but one in which the intensity is below normal at the start of the glide, changing to above normal at a point near the end of the glide. A service installation was put into operation at Tempelhof in September 1933, and four airplanes were equipped to make use of it.

At Zürich-Dübendorf, Switzerland, a similar blind landing system was installed and was expected to be put into operation in January 1934.

Engineers from a number of other countries, including Holland, Japan, and the Union of Socialist Soviet Republics, have visited the Bureau of Standards laboratories and the installation at the Newark, N.J., Airport to make a study of the system.

In England there has been installed at the Croydon Airport a radiobeacon of the visual type similar to that developed by the Bureau. The Marconi's Wireless Telegraph Co. has developed a modified form of the reed indicator for this system. Instead of rotating the reed unit as a whole in its shock mounting, the face only is rotated; this requires an eccentric window and extended white tab on the 65-cycle reed. It is understood that the beacon is ready for regulator operation, working in conjunction with another visual-type beacon at Paris (Le Bourget Airport), France.

In France two of the visual-type beacons are in use, the one at Paris and another at Lyon. The same modulation frequencies, 65 and 86% cycles, are used at all the beacons. The French beacons differ from the original American design in that the modulation frequencies are introduced by rotary condensers in the antenna circuits. Reed indicators identical with those originally developed by the Bureau are used. The French installations were made by the Societe d'Entreprises Electro-Techniques. Publications describing the system state that it has proved very successful and is in daily use.

A GLASS ELECTRODE POTENTIOMETER SYSTEM FOR THE DETERMINATION OF THE pH VALUES OF WEAKLY-BUFFERED SOLUTIONS

In the electrometric measurement of the pH values of buffered solutions, more dilute than M/10,000, by means of quinhydrone and hydrogen electrodes, the resistance of the solution, escape of carbon dioxide, acid properties of the quinhydrone, and polarization of the electrodes are so disturbing that the emf readings may vary as much as 5 to 30 mv or 0.1 to 0.5 pH unit. The isohydric-indicator technique is apparently applicable within 0.1 pH to such solutions, and distilled water, but has not heretofore been compared with a reliable emf method. By adding Varley shunts to a modification of the vacuum-tube potentiometer used by Partridge, keeping the grid attached to the circuit, and using a Thompson glass electrode, emf read-

ings can be made within 0.1 to 2.0 mv on weekly-buffered solutions and distilled water, and the pH values agree with those obtained by the isohydric-indicator method. This apparatus is also suitable for measuring the pH of solutions containing active or reducing agents, such as chlorine or tannins, where the hydrogen and quinhydrone electrodes and indicator methods might fail. For a complete description, Research Paper No. 634, in the January number of the Bureau of Standards Journal of Research, should be consulted.

CHANGE IN VOLUME OF RUBBER ON STRETCHING

Rubber shows the anomalous property of decreasing in volume when it is stretched. Other substances increase in volume. Some measurements of the volume decrease on stretching were undertaken at the Bureau in order to obtain precise values for Poisson's ratio to be used in the determination of the photoelastic constants of rubber. The striking observation was made that the volume decrease was not instantaneous but required several minutes for its completion. This effect is not a function of the change in tension with time, because the behavior on successive cycles of stretching is identical. The effect apparently depends on the time lag in the development of the fiber structure of stretched rubber which was recently discovered by Professor Davey and his colleagues of State College, Pennsylvania, in connection with X-ray diffraction patterns of stretched rubber.

ANALYSIS OF WOOL-COTTON TEXTILES

As a result of recent standardization activities, there has arisen a need for a more accurate method for the determination of wool in mixtures of wool and cotton. For example, the trade practice ruling adopted on May 26, 1930 by the Federal Trade Commission requires that "the word 'wool' shall not be used in any way in the labeling, advertising, merchandising, or selling of knit underwear unless the percentage by weight of wool contained in the garment is stated." The Commercial Standard for "Wool and part-wool blankets", established by the joint action of producers, distributors, and users, effective April 1, 1933, provides for the labeling of part-wool blankets with the guarantee minimum

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wool content. Moreover, part-wool textiles are often purchased on specifications requiring a definite wool content.

Several methods for the determination of cotton and wool in mixtures have been studied by the textile section of the Bureau. A report of this investigation, showing the inadequacy of some of the methods and describing a satisfactory procedure, will be published in the January issue of the Bureau of Standards Journal of Research, as Research Paper no. 635. In the method recommended, sizing, finishing materials, and natural non-fibrous constituents of the textiles are removed by solvent extraction followed by digestion with a starch-hydrolyzing enzyme, and washing. Wool is determined directly by weighing after removal of the cotton by carbonization with aluminum chloride. Cotton is determined directly by weighing after removal of the wool with potassium hydroxide. Results accurate within 1 percent of the amount of total dry fiber present are readily obtainable by this method.

EFFECT OF HUMIDITY AND TEMPERATURE ON LITHOGRAPHIC PAPERS

In a study of the reactions of lithographic papers to humidity and temperature, valuable data have been obtained by the Bureau to assist the industry in combatting serious economic losses resulting from register difficulties. (Technical News Bulletins nos. 165, 189, 191, and 193). The avidity of paper for moisture, and the fact that its dimensions change with gain or loss of moisture, have contributed largely to the lithographers most serious difficulty, misregister of prints. Hence, the Bureau, in cooperation with the Lithographic Technical Foundation, has made extensive studies to determine what happens to large sheets of lithographic papers when subjected to atmospheric changes, under accurately controlled conditions. Weather was "manufactured" for the study by means of an air-conditioning unit capable of controlling the relative humidity of the air to within ± 0.5 percent and the temperature to within 0.5 F. Paper dimensions were checked accurately to 0.002 inch with a micrometer rule, and weight determinations were made to 0.1 milligram on a sensitive chemical balance. Various humidities ranging from 27 to 72.5 percent with constant temperature, and

various temperatures ranging from 68 to 110 F. with constant relative humidity were used. Papers of known response to offset printing were taken through complete cycles of humidity changes to find the significance of history of conditioning, and papers with various moisture contents were conditioned at the humidity used by many lithographers to find the influence of moisture content on conditioning time.

When the papers were arranged in accordance with their coefficients of expansion in the machine direction, or "with the grain" as it is often termed, it was found that the same order resulted as when the papers were placed according to quality of register as determined in previous printing tests. The paper that gave best register in printing changed least in the machine direction with moisture content changes, and the paper that gave poorest register in printing changed most. This indicates that the troublesome changes of dimensions that have the most important influence on register of prints are caused by moisture content changes, rather than by the mechanical stresses of the process. Therefore, the importance of accurate atmospheric control, together with proper conditioning of paper in quality multi-color printing, is obvious.

The importance of fiber formation of paper for best register of prints was evidenced by low-machine direction coefficient of expansion in the case of papers made with large directional difference. The desirable directional difference was obtained by keeping mechanical treatment of fibers in manufacture at a minimum, and controlling formation so that the greatest possible number of fibers will be parallel to the machine direction. A report on this work, which will be published as Research Paper No. 633 in the January number of the Bureau of Standards Journal of Research, contains a number of specific recommendations for lithographers.

REMOVAL OF SULPHUR DIOXIDE FROM LIBRARY AIR

An error occurs in this item on page 129 of Technical News Bulletin no. 200 (December 1933). The publication is referred to as Miscellaneous Publication no. 141, whereas the number should be 142. However, the number is given correctly in the list of Bureau publications on page 132.

NEW AND REVISED PUBLICATIONS ISSUED DURING DECEMBER 1933

Journal of Research¹

Bureau of Standards Journal of Research, vol. 11, no. 6, December 1933 (RP nos. 620 to 629, with index to volume 11). Price 25 cents. Obtainable by subscription.

Research Papers¹

(Reprints from September and October 1933 Bureau of Standards Journal of Research.)

RP597. A continuous recorder of radio field intensities; K. A. Norton and S. E. Reymer. Price 5 cents.

RP600. Effect of weave on the properties of cloth; H. F. Schiefer, R. S. Cleveland, J. W. Porter, and J. Miller. Price 5 cents.

RP601. The isotopic fractionation of water; E. W. Washburn, E. R. Smith, and M. Frandsen. Price 5 cents.

RP602. Performance tests of radio system of landing aids; H. Diamond. Price 10 cents.

RP603. Tests of theatre-proscenium curtains; N. D. Mitchell. Price 5 cents.

RP605. The utility of the spark test as applied to commercial steels; R. W. Buzzard. Price 5 cents.

RP606. The system liquid iron-carbon oxides; H. C. Vacher. Price 5 cents.

RP607. A simple calorimeter for heats of fusion. Data on the fusion of pseudocumene, mesitylene (alpha and beta), o- and m-xylene, and on two transitions of hemimellitene; F. D. Rossini. Price 5 cents.

RP608. Note on a multi-frequency automatic recorder of ionosphere heights; T. R. Gilliland. Price 5 cents.

Simplified Practice Recommendations¹

R22-33 (2d ed.). Paper (basic sheet sizes). Price 5 cents.

Commercial Standards¹

CS31-33 (2d ed.). Wood shingles (red cedar, tidewater red cypress, California redwood). Price 5 cents.

Miscellaneous Publications¹

M143. Psychrometric charts; D. B. Brooks. Price 5 cents.

Technical News Bulletin¹

Technical News Bulletin no. 200, December 1933. Price 5 cents. Obtainable by subscription.

LETTER CIRCULARS²

LC395. Preparation and colorimetric properties of a magnesium-oxide reflectance standard.

LC396. Publications relating to textiles.

LC397. Can I save gas with a gas saver? (This applies to the use of so-called gas savers, attachable solid tops, and other appliances on cooking ranges.)

LC398. Publications on colorimetry and spectrophotometry from the Bureau of Standards.

LC399. Weights and measures publications of general interest. (Revision of LC243.)

LC400. Sources of radio information. (Revision of LC274.)

LC401. Railroad track scale testing service of the National Bureau of Standards, fiscal year July 1, 1932, to June 30, 1933.

OUTSIDE PUBLICATIONS³

Crittenden, E. C., The work of the Bureau of Standards in electricity and radio, The Scientific Monthly (New York, N.Y.), vol. 37, p. 405, November 1933.

Lloyd, M. G., The safety code work of the Bureau of Standards, Industrial Standardization and Commercial Standards Monthly (American Standards Association, New York, N.Y.), vol. 4, no. 12, p. 203, December 1933.

Lloyd, M. G., Lightning protection for trees, Science (Grand Central Terminal, New York, N.Y.), vol. 78, no. 2035, p. 603 December 29, 1933.

Paffenbarger, G. C., Sweeney, W. T., and Isaacs, A., A preliminary report on the zinc phosphate cements; Journal American Dental Association (Chicago, Ill.), vol. 20, p. 1960, November 1933.

ington, D.C. Subscription to Technical News Bulletin, 50 cents per year; Journal of Research, \$2.50 per year (United States and its possessions, Canada, Cuba, Mexico, Newfoundland, and Republic of Panama); other countries 70 cents and \$3.25, respectively.

² It is the intent of the Bureau to distribute single copies of these Letter Circulars on request only to those parties having special interest in the individual Letter Circular. Economy necessitates limitation in the number of copies issued. It is not the intent to supply parties with a copy of each letter circular issued during the month. Letter circulars are necessarily of a temporary nature designed to answer numerous inquiries on a given subject. Requests should be addressed to the Bureau of Standards, Washington, D.C.

³ "Outside publications" are not for sale by the Government, unless otherwise noted. Requests should be sent direct to publishers.

¹ Send orders for publications under this heading only to the Superintendent of Documents, Government Printing Office, Wash-

- Southard, J. C., and Brickwedde, F. G., Low temperature specific heats. I. An improved calorimeter for use from 14 to 300 K. The heat capacity and entropy of naphthalene. *Journal of the American Chemical Society* (Washington, D.C.), vol. 55, p. 4378, November 1933.
- Southard, J. C., and Milner, R. T., Low temperature specific heats. II. The calibration of the thermometer and the resistance of platinum, platinum-10 percent rhodium and constantan between -259 and 190 C, *Journal of the American Chemical Society* (Washington, D.C.), vol. 55, p. 4384, November 1933.
- Garlock, E. A., and Ellis, Greer, The effect on engine performance of change in jacket-water outlet temperature, National Advisory Committee for Aeronautics (Washington, D.C.) Technical Note no. 476, November 1933. (This is a Government publication, obtainable free from the N.A.C.A.)
- Coblentz, W. W., Sources of artificial radiation and their physical properties. Principles and practices of physical therapy (W. F. Proctor and Company, Hagerstown, Md.), vol. 1, chapter 9, revised December 1933.
- Taylor, L. S., Singer, G., and Stoneburner, C. F., A basis for the comparison of Roentgen rays generated by voltages of different wave form, *American Journal of Roentgenology* (Detroit, Mich.), vol. 30, p. 368, September 1933.
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